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Nakano

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(54) **IMAGE FORMING APPARATUS WITH COMBINED BELT UNIT AND SHEET GUIDE MEMBER**

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(51) **Int. Cl.**
G03G 15/06 (2006.01)

(52) **U.S. Cl.** **399/121**

(58) **Field of Classification Search** 399/121, 399/124

See application file for complete search history.

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(57) **ABSTRACT**

A laser printer has an opening formed at its front surface side and a front cover for opening and closing the opening. A belt unit is attachably and detachably provided with respect to a body casing via the opening in a state where the front cover is opened. A guide member for guiding a sheet of paper is provided at the front of the belt unit. The belt unit is combined with the guide member, which is provided to be attachable and detachable with respect to the body casing.

11 Claims, 13 Drawing Sheets

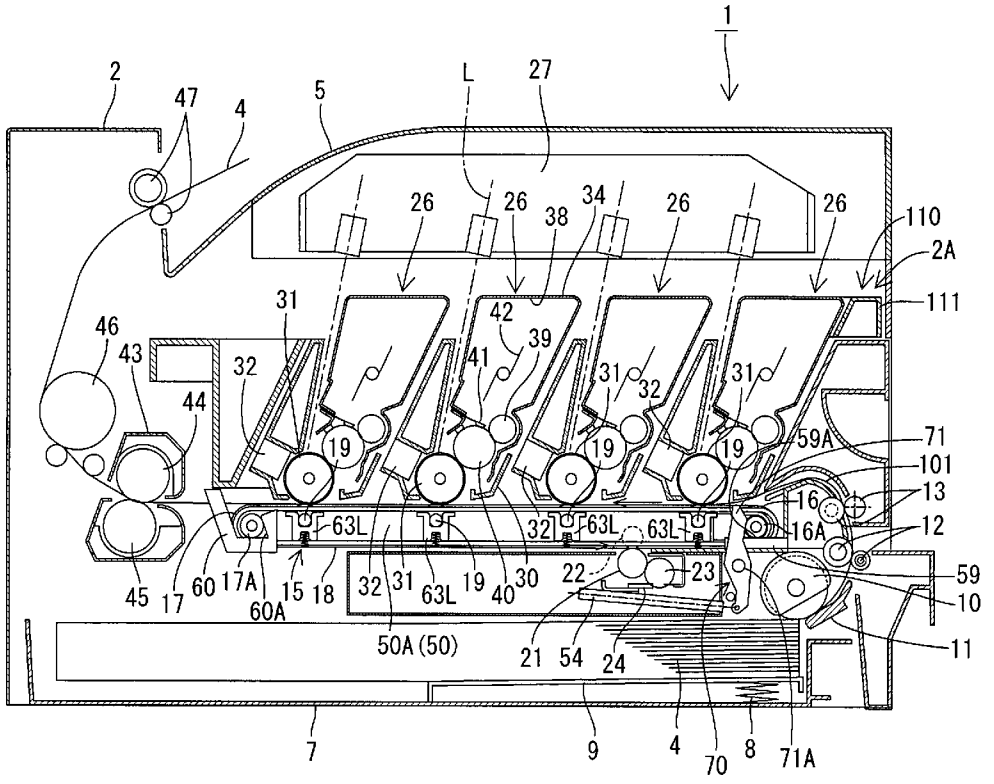

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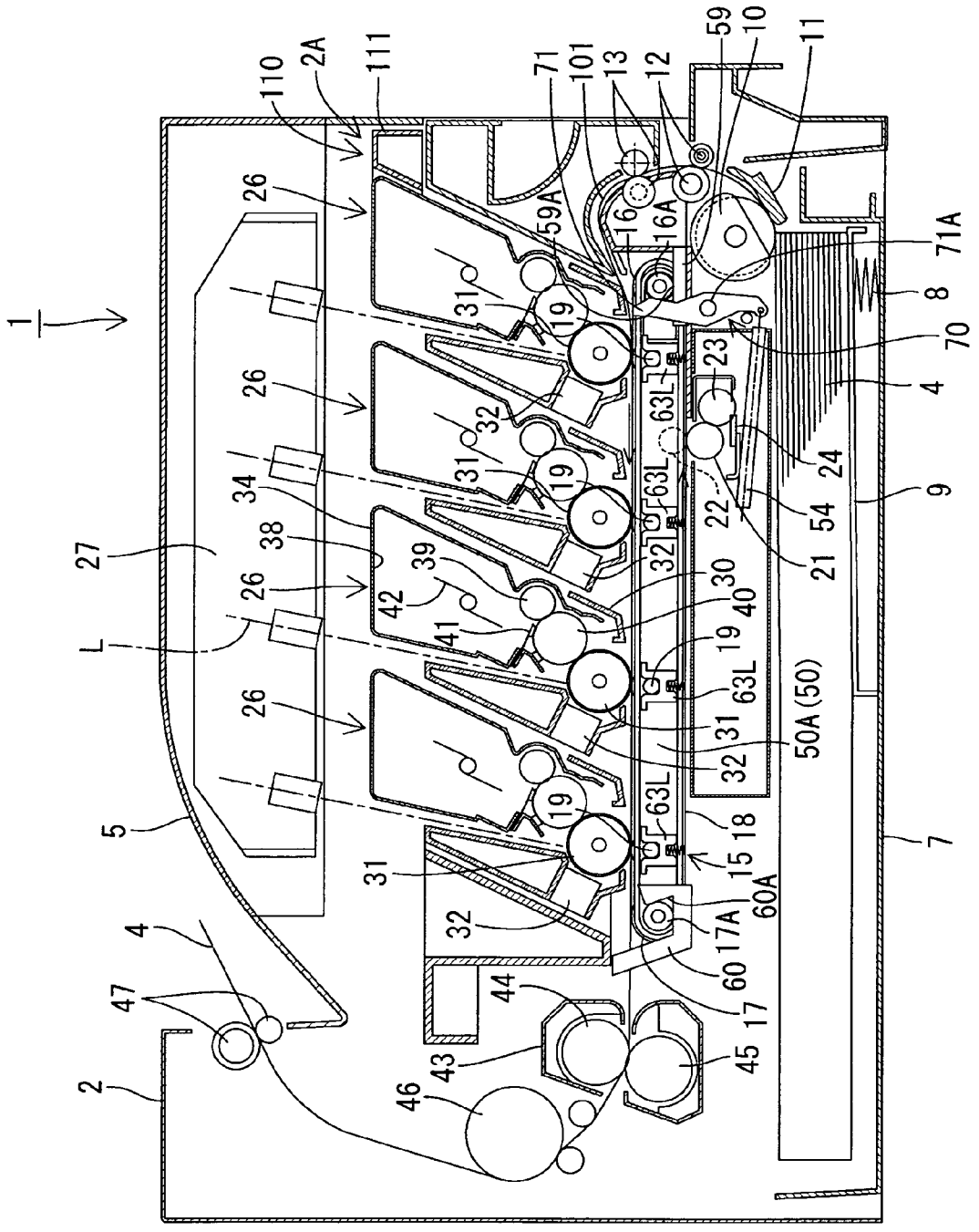
FIG.1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71
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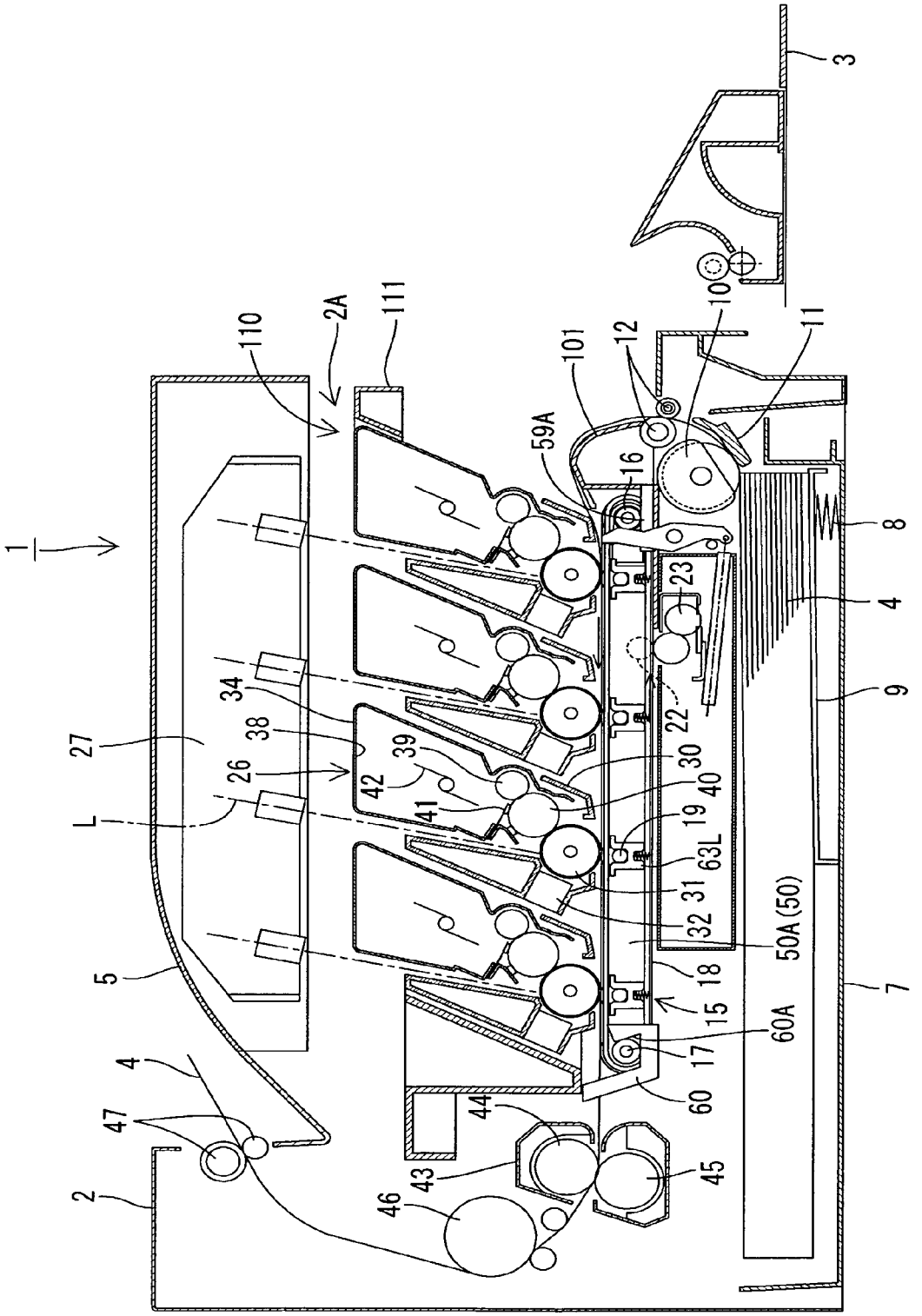
FIG.2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31
32
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38
39
40
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47
50A (50)
59A
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101
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FIG.3

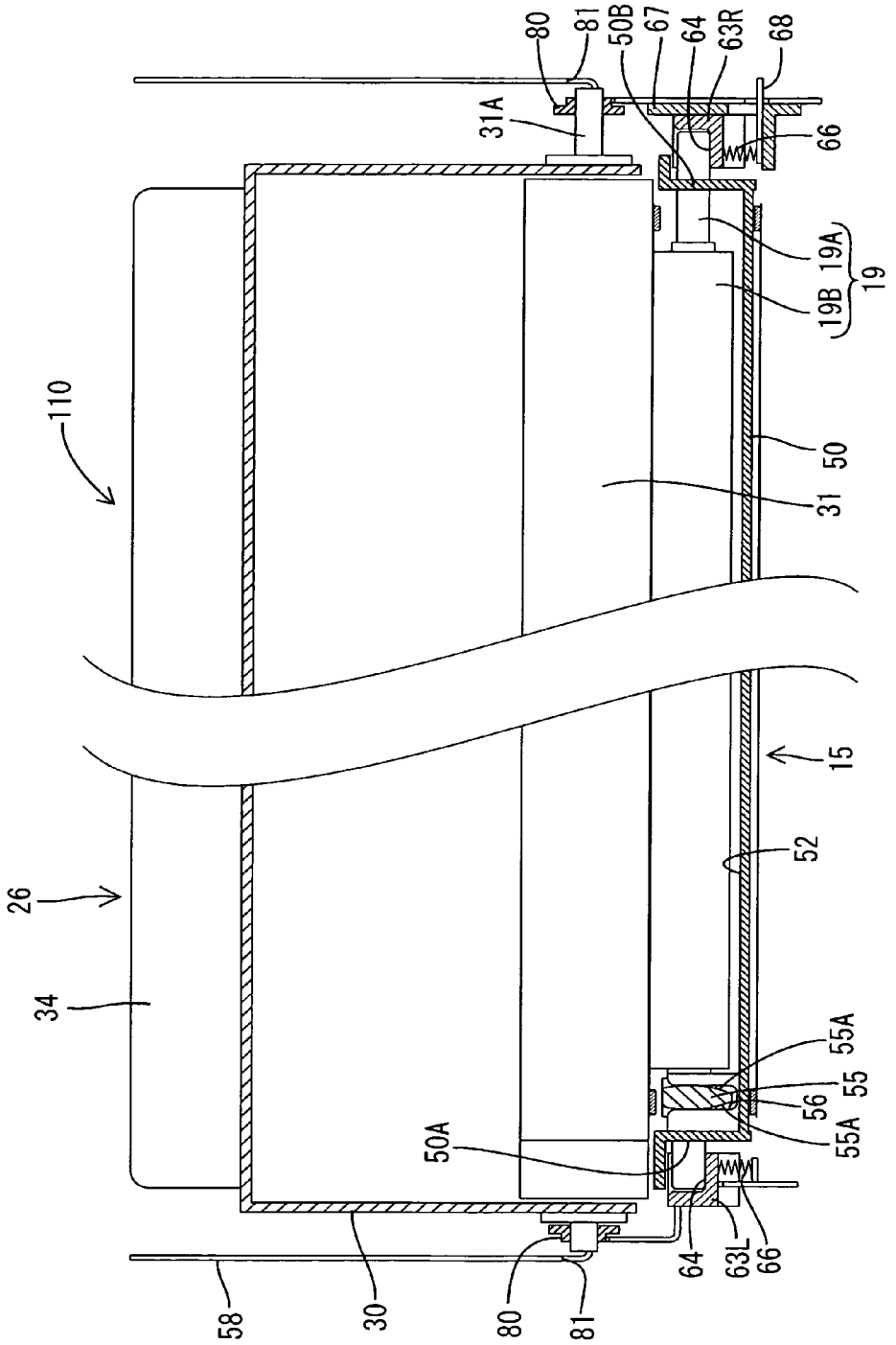
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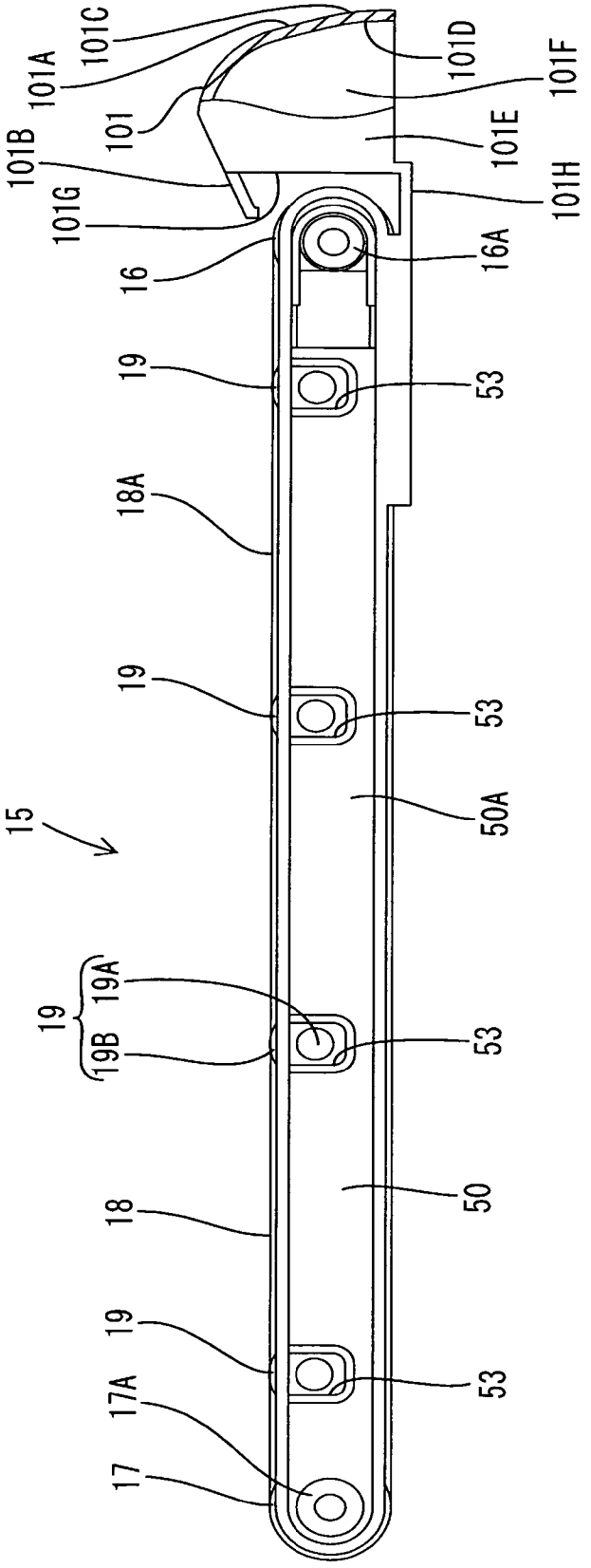
FIG.4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16
16A
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50A
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19A
19B
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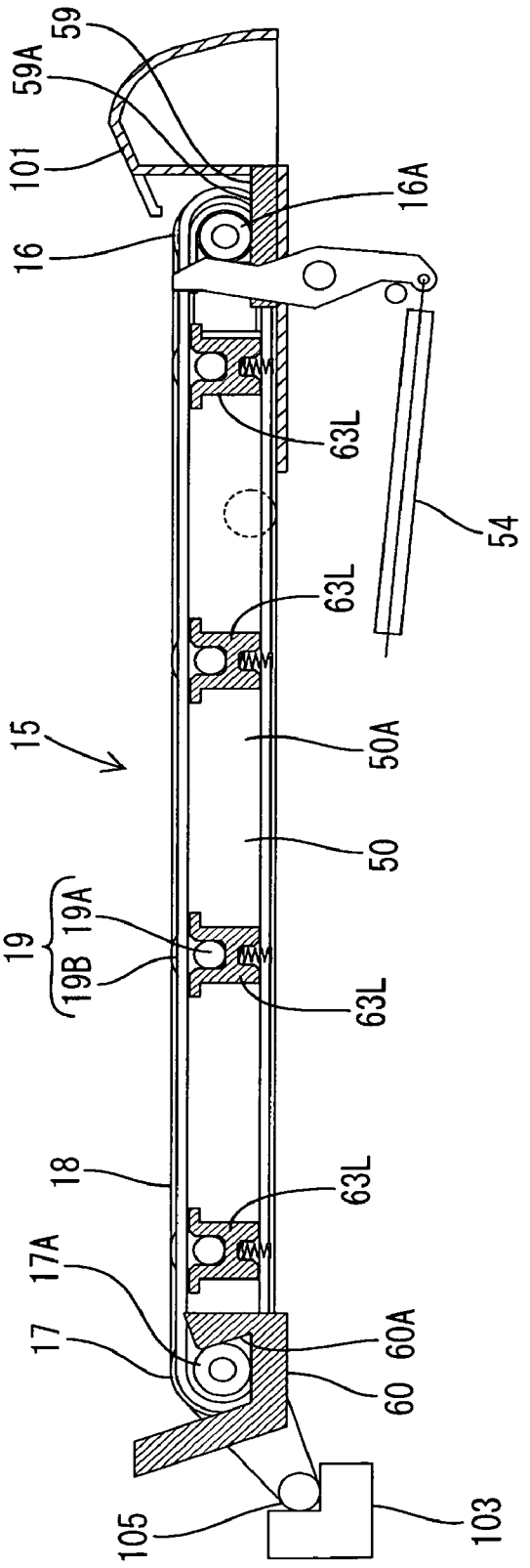
17A
17
53

FIG.5A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105
103

FIG.5B

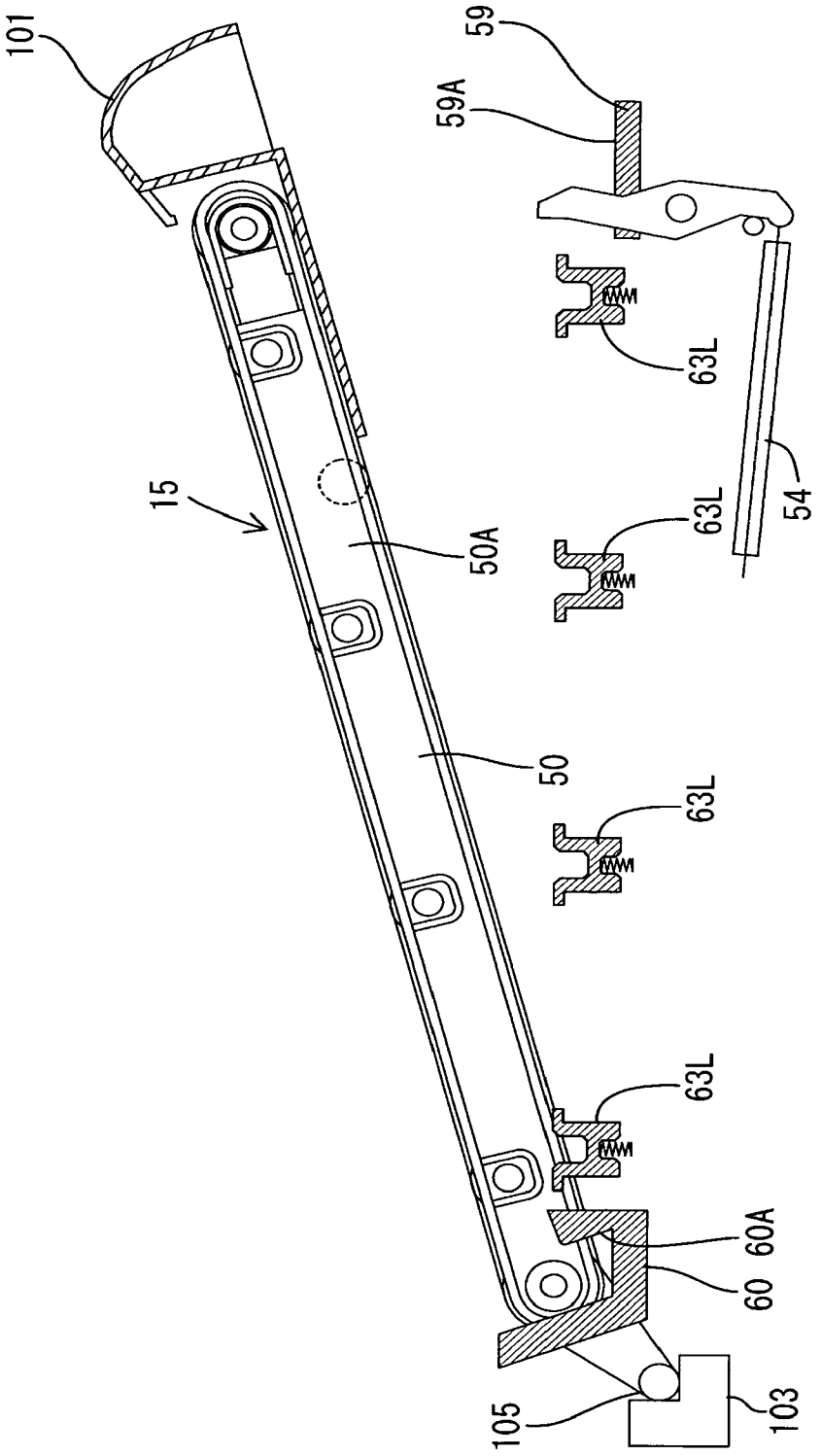

FIG.6

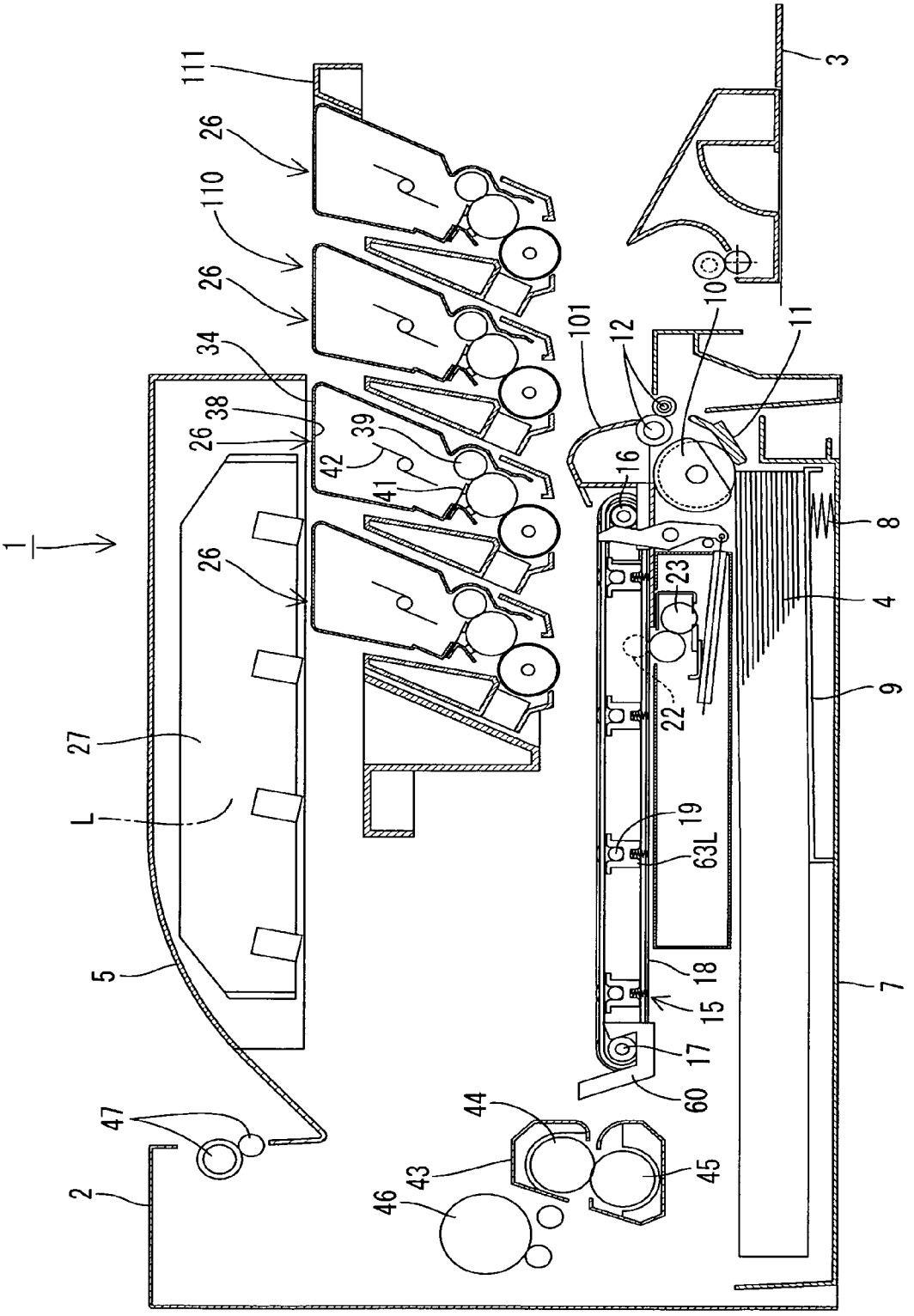
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FIG.7

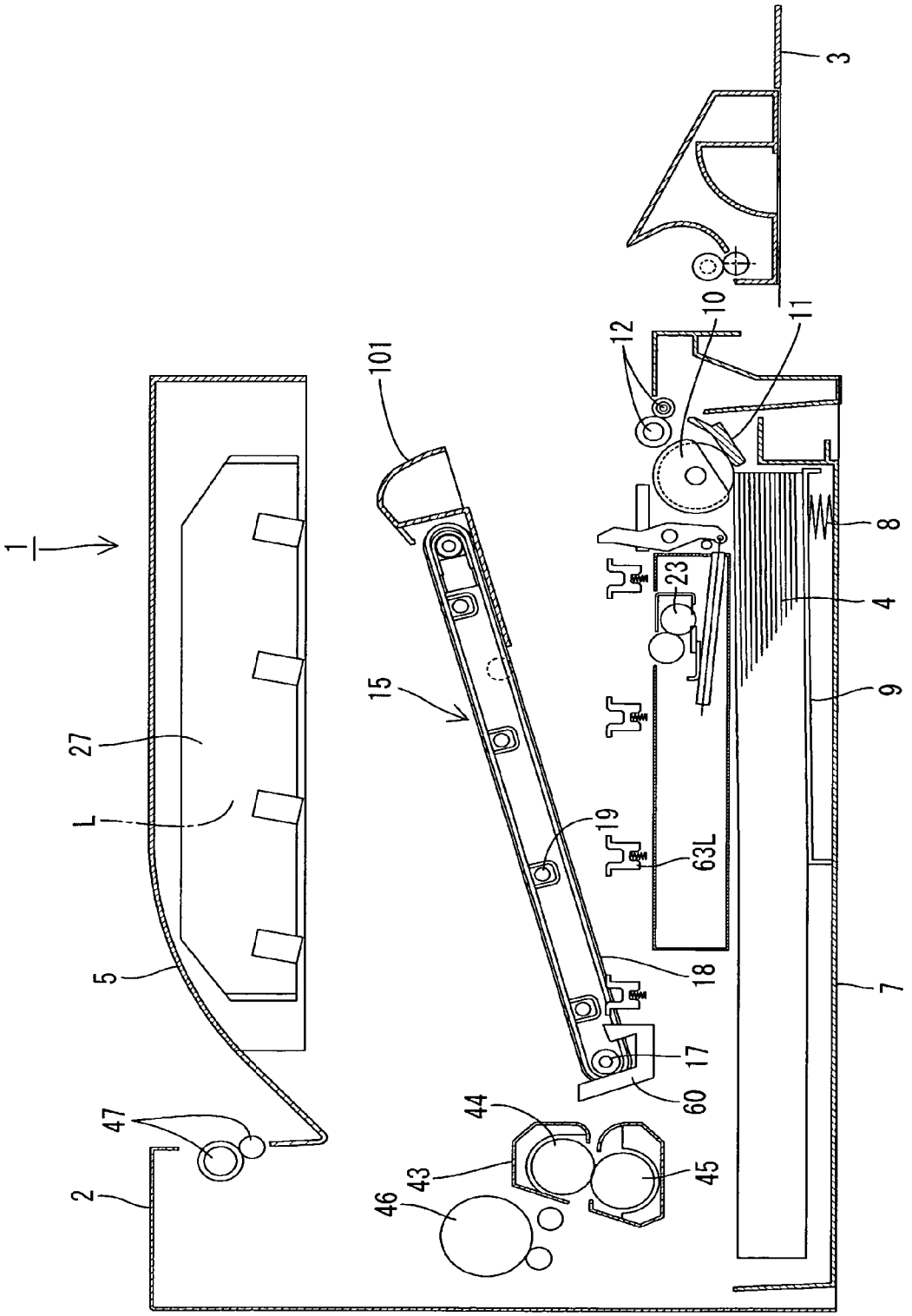

FIG.8

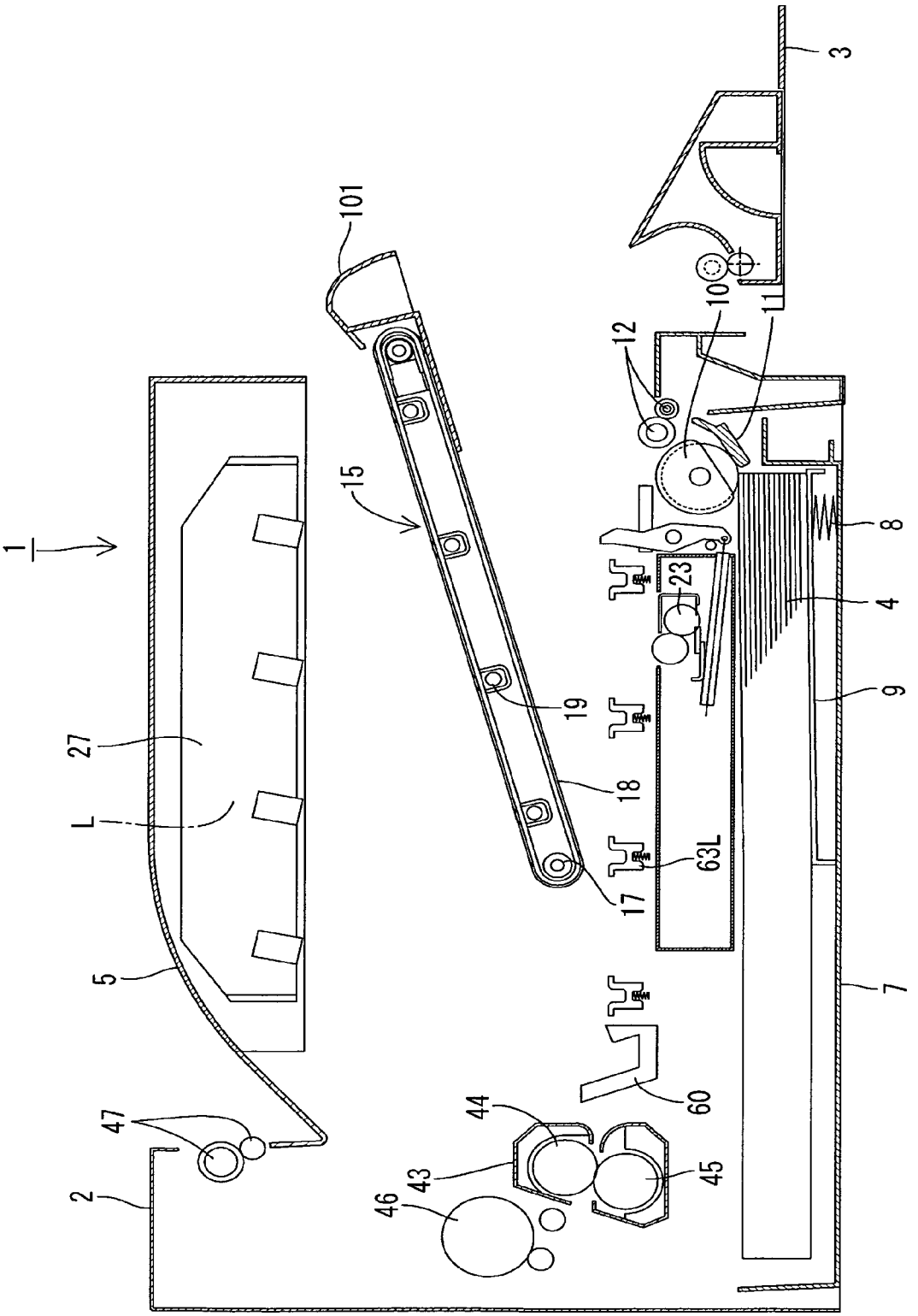

FIG.9

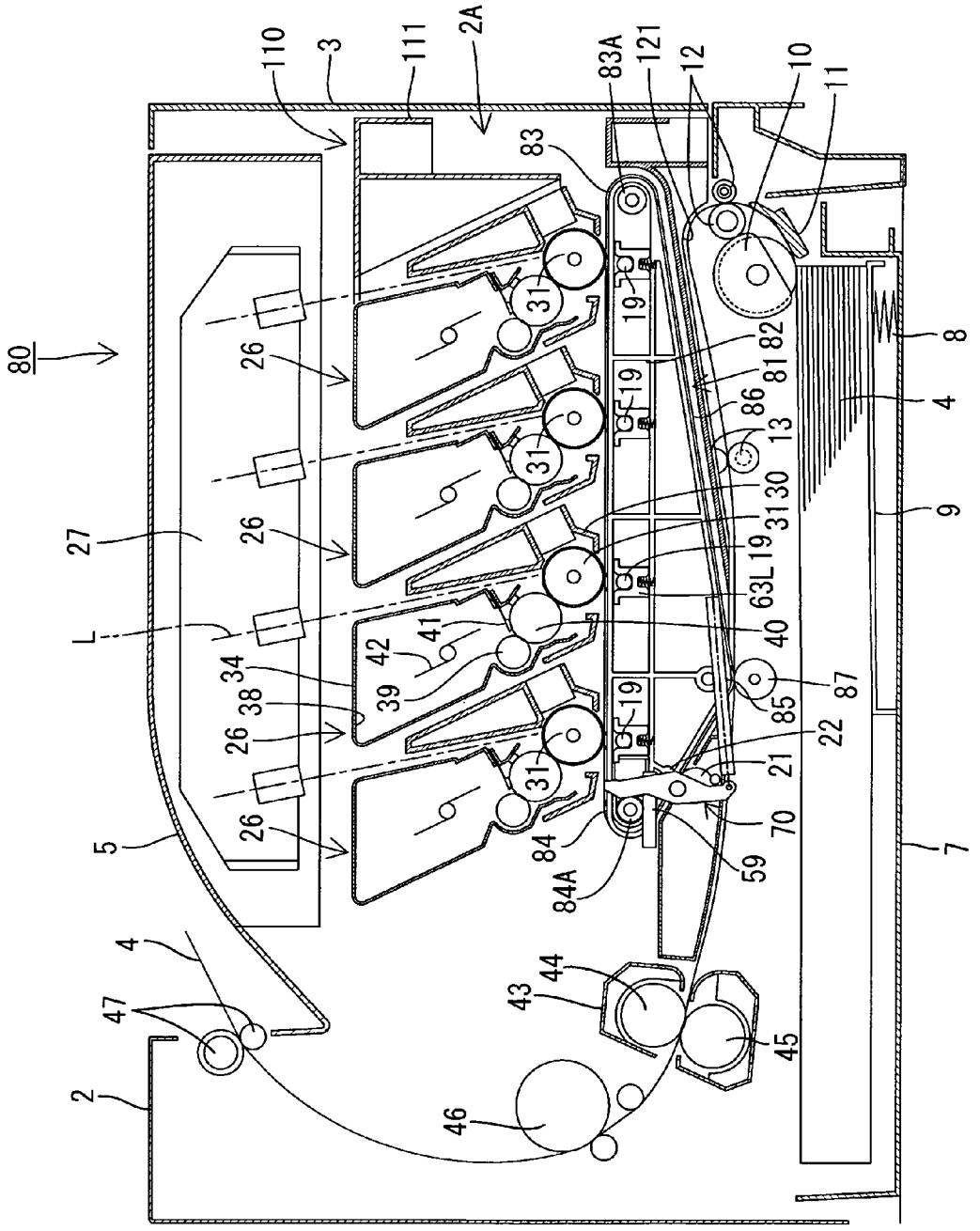
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FIG.10

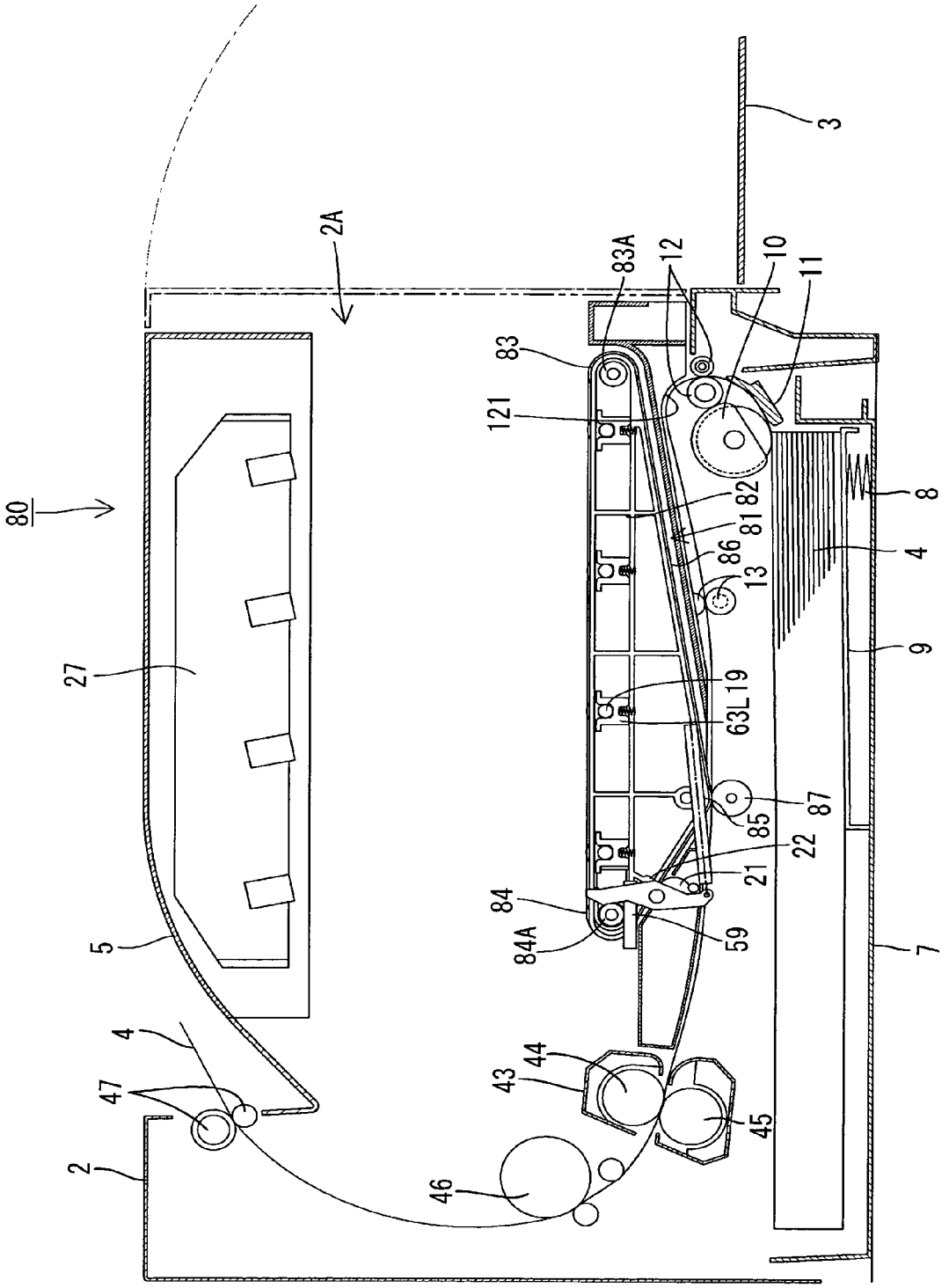
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FIG.11

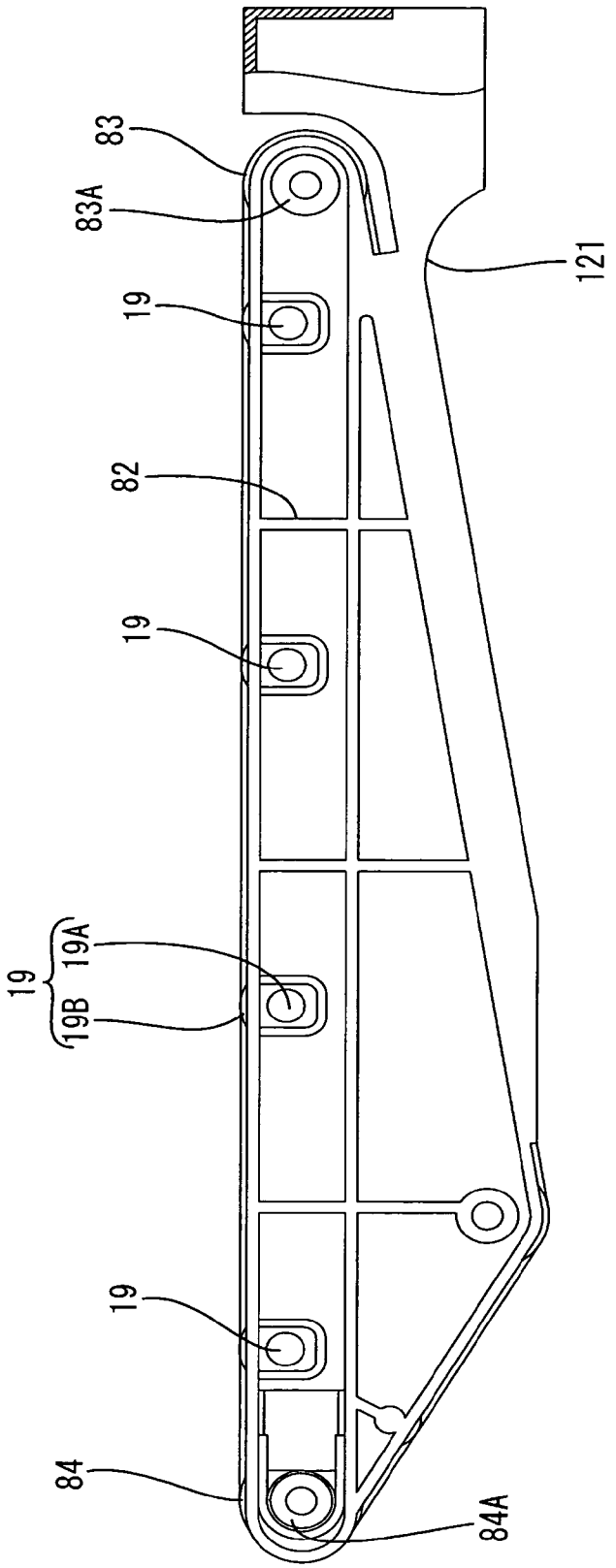

FIG.12

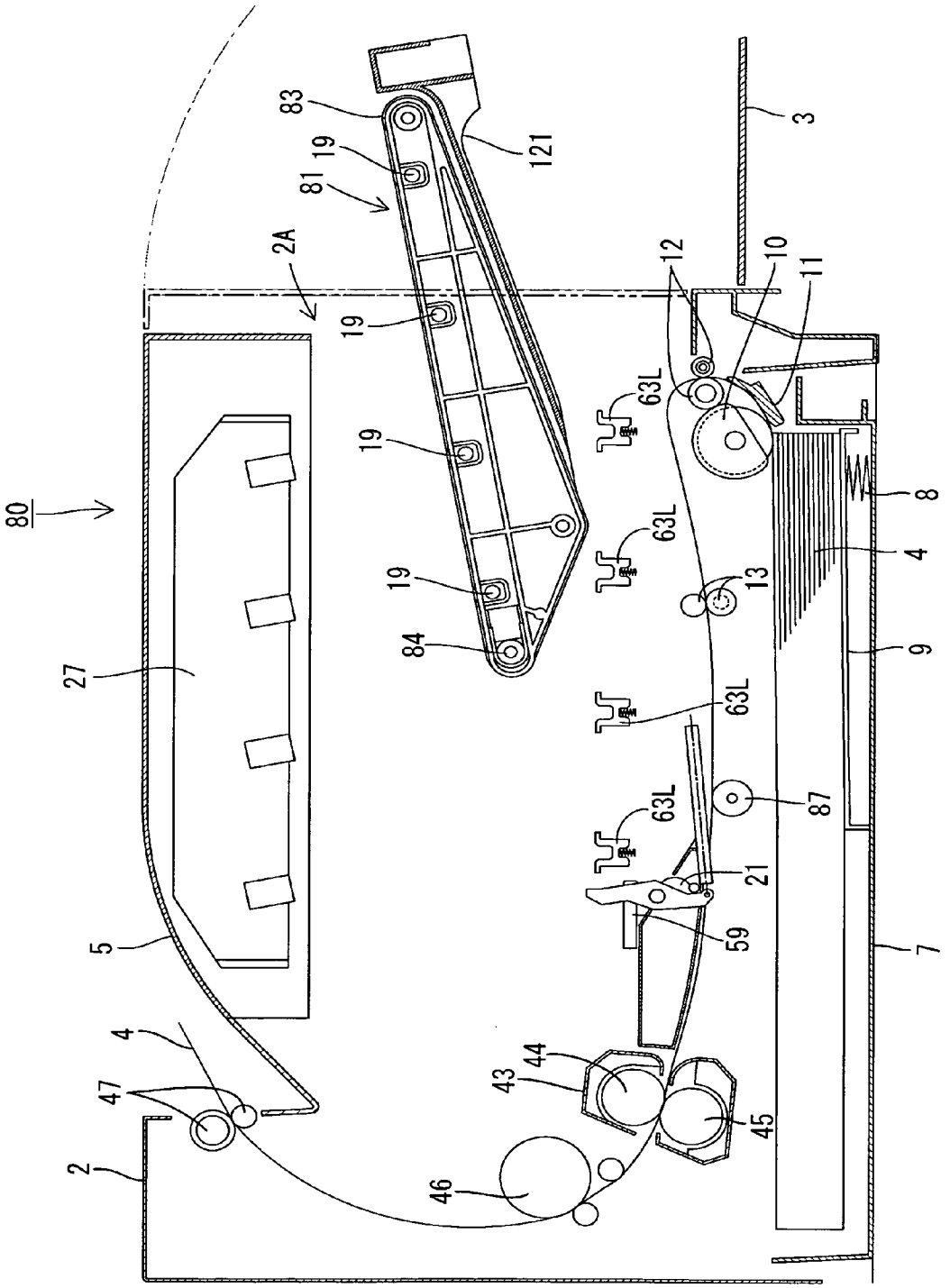
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IMAGE FORMING APPARATUS WITH COMBINED BELT UNIT AND SHEET GUIDE MEMBER

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority from Japanese Patent Application No. 2005-244499 filed Aug. 25, 2005. The entire content of this priority application is incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to an image forming apparatus.

BACKGROUND

A known image forming apparatus such as a laser printer employs an endless belt for the purpose of carrying a sheet of paper, performing an intermediate transfer and the like. The aforementioned belt is detachably installed as a unit in the device for maintenance, replacement and the like.

It is preferable to form the aforementioned belt unit as compact as possible for performing efficient and easy maintenance. If the belt unit as a whole is enlarged, there may be difficulties in attachment or detachment of the unit with respect to the device, and the attachment/detachment mechanism (for example, slide mechanism) has to be enlarged accordingly. A mere simplification of the belt unit structure, however, may cause difficulties in finding the portion to be gripped other than the belt. The possibility to cause the operator to come into contact with the belt becomes substantially high, which is likely to give the damage to the belt.

Thus, there is a need in the art for an image forming apparatus that allows easy attachment or detachment of a belt unit as well as excellent maintenance performance.

SUMMARY

The image forming apparatus as one aspect of the invention is provided with a storage portion that stores a recording medium, an ejection mechanism that ejects the recording medium stored in the storage portion, and an image forming portion that forms an image on the recording medium within a body casing. The recording medium ejected by the ejection mechanism is guided by a guide member toward a predetermined direction, and further carried toward the image forming portion by a belt unit. The belt unit includes a frame portion, a plurality of support rollers rotatably provided to the frame, and a carrier belt extended between the support rollers for carrying the recording medium guided by the guide member. The guide member and the belt unit are combined into a single unit so as to be attachable to and detachable from the body casing.

In the aforementioned structure, since the belt unit and the guide member have been combined into the single unit, the guide member, which functions as a portion for guiding the recording medium, can also function as the grip portion during attachment or detachment of the belt unit. The belt unit, thus, may be easily attached or detached, and the maintenance is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

Illustrative aspects in accordance with the invention will be described in detail with reference to the following figures wherein:

FIG. **1** is a sectional view schematically showing an example structure of a laser printer according to the present invention;

FIG. **2** is a sectional view of the laser printer shown in FIG. **1** having a front cover opened;

FIG. **3** is a front sectional view showing a support mechanism of a transfer roller and a photosensitive drum;

FIG. **4** is a side view showing a belt unit and a guide member of the laser printer shown in FIG. **1**;

FIG. **5**A is a sectional view showing a state where the belt unit and the guide member are installed in a body of the device;

FIG. **5**B is a sectional view showing a state where the belt unit and the guide member are detached from the body;

FIG. **6** is a sectional view of the laser printer shown in FIG. **1** in the state where an image forming unit is pull out;

FIG. **7** is a sectional view of the laser printer shown in FIG. **1** in the state where the belt unit is displaced from its set position;

FIG. **8** is a sectional view of the laser printer shown in FIG. **1** in a state where the belt unit is completely detached;

FIG. **9** is a sectional view schematically showing another example structure of the laser printer according to the present invention;

FIG. **10** is a sectional view of the laser printer shown in FIG. **9** in the state where the front cover is opened, and the image forming unit is detached;

FIG. **11** is a sectional view showing the belt unit and the guide member of the laser printer in FIG. **9**; and

FIG. **12** is a sectional view of the laser printer shown in FIG. **9** in the state where the belt unit is completely detached.

DETAILED DESCRIPTION

A first example structure of the image forming apparatus as an aspect of this invention will be described referring to FIGS. **1** to **8**.

A laser printer **1**, which is a color laser printer of direct transfer tandem type, includes a substantially box-like body casing **2** as shown in FIG. **1**. A front cover **3** that can be opened and closed is attached to a front surface (right side of the drawing) of the body casing **2**. Process cartridges **26** or a belt unit **15** within the body casing **2** may be replaced by opening the front cover **3** as shown in FIG. **2**. An ejected paper tray **5** on which sheets of paper **4** that have been subjected to the image forming process are stacked is formed on the upper surface of the body casing **2**.

A paper feed tray **7** on which the sheets of paper **4** subjected to the image forming process are stacked is set so as to be withdrawn forward. A platen **9** that is tiltably operated under the urging force of a spring **8** so as to lift up the front edge of the paper **4** is provided within the paper feed tray **7**. A pick-up roller **10** and a separation pad **11** in pressure contact therewith under the urging force of a spring (not shown) are provided above the front end of the paper feed tray **7**. A pair of paper feed rollers **12** are provided diagonally forward above the pick-up roller **10**, and a pair of resist rollers **13** are further provided above the pair of paper feed rollers **12**.

The upper most paper **4** among those stacked on the paper feed tray **7** is pressed toward the pick-up roller **10** by the platen **9**. As the pick-up roller **10** rotates, the paper **4** is sandwiched between the pick-up roller **10** and the separation pad **11** so as to be separated and fed one by one. The paper **4** that has been fed from the sandwiched state between the pick-up roller **10** and the separation pad **11** is further carried to the resist rollers **13** by the paper feed rollers **12**. The paper

4 is fed by the resist rollers **13** to the belt unit **15** backward thereof at a predetermined timing.

The belt unit **15** is structured to be attachable to and detachable from the body casing **2**, and provided with a carrier belt **18** that horizontally extends between a pair of support rollers **16**, **17**, which are apart from each other in the front-rear direction. The support roller **17** at the rear is a drive roller that is rotated to be driven by power of a motor (not shown), and the support roller **16** at the front is a tension (driven) roller for applying a tensile force to the carrier belt **18**, which will be described later. The carrier belt **18** is an endless belt formed of a resin material, for example, polycarbonate and the like. It is operated to circulate counterclockwise as shown in FIG. **1** when the support roller **17** as the drive roller is rotated to be driven such that the paper **4** placed on the carrier belt **18** is carried backward. Photosensitive drums **31** and four transfer rollers **19** each oppositely provided in the respective process cartridges **26** are arranged at constant intervals in a longitudinal direction at the inside of the carrier belt **18**. The carrier belts **18** are, thus, interposed between the respective photosensitive drums **31** and the corresponding transfer rollers **19**. During the transfer process, the transfer bias is applied between the transfer rollers **19** and the photosensitive drums **31**, respectively. The structure of the belt unit **15** will be described later.

A cleaning roller **21** is provided below the belt unit **15** for removing toner or paper dust adhered to the carrier belt **18**. The cleaning roller **21** is formed by applying a foaming material, for example, silicon around a metal shaft member, opposite to the metal back-up roller **22** provided on the belt unit **15** with respect to the carrier belt **18**. A predetermined bias voltage is applied between the cleaning roller **21** and the back-up roller **22** such that the toner on the carrier belt **18** may be electrically introduced to the cleaning roller **21**. The cleaning roller **21** abuts against a metal recovery roller **23** for removing the toner adhered thereon. The recovery roller **23** further abuts against a blade **24** that scratches to remove the toner adhered on the recovery roller **23**.

Four process cartridges **26** corresponding to such colors as Magenta, Yellow, Cyan and Black, respectively are detachably arranged in the longitudinal direction above the belt unit **15**. A scanner portion **27** provided above those process cartridges serves to irradiate a laser beam L corresponding to the respective colors onto a surface of the corresponding photosensitive drum **31** on the basis of the image data through rapid scanning.

The process cartridge **26** includes a cartridge frame **30**, a photosensitive drum **31** and a scorotron type electrifier **32** provided below the cartridge frame **30**, and a development cartridge **34** detachably set to the cartridge frame **30**.

The photosensitive drum **31** is formed by coating a positively charged photosensitive layer formed of a polycarbonate, for example around a surface layer of a metal drum body that has been grounded.

The scorotron type electrifier **32** is provided diagonally backward above the photosensitive drum **31** such that they face with each other at a predetermined interval so as not to contact with each other. The scorotron electrifier **32** serves to positively electrify over a whole surface of the photosensitive drum **31** uniformly by causing the wire for charging, for example, tungsten, to generate a corona discharge.

The development cartridge **34** has a substantially box-like shape having a toner containing chamber **38** at the upper portion, and a supply roller **39**, a development roller **40**, and a layer thickness control blade **41** provided at the lower portion. Each of the toner containing chambers **38** contains non-magnetic single component toner that has been positively charged as the development agent for such colors as Yellow, Magenta, Cyan, and Black, respectively. Each of the respective toner containing chambers **38** is provided with an agitator **42** that agitates the toner.

The supply roller **39** is formed by coating a metal roller shaft with a conductive foaming material. The development roller **40** is formed by coating a metal roller shaft with a conductive rubber material. The toner discharged from the toner containing chamber **38** is supplied to the development roller **40** accompanied with the rotation of the supply roller **39**, and positively friction charged between the supply roller **39** and the development roller **40**. The toner supplied onto the development roller **40** proceeds between the layer thickness control blade **41** and the development roller **40** in conjunction with the rotation of the development roller **40** and is further friction charged sufficiently so as to be carried on the development roller **40** to form a thin layer with a uniform thickness.

The surface of the photosensitive drum **31** during rotation is uniformly charged positively by the scorotron electrifier **32**. Thereafter it is exposed to rapid scanning of the laser beam from the scanner portion **27** such that the electrostatic latent image corresponding to the image to be formed on the paper **4** is generated.

Upon rotation of the development roller **40**, the toner carried thereon that has been positively charged is brought into contact with the opposite photosensitive drum **31** such that the toner is supplied to the electrostatic latent image generated on the surface of the photosensitive drum **31**. Accordingly the electrostatic latent image on the photosensitive drum **31** may be visualized, that is, the toner image is carried on the surface of the photosensitive drum **31**.

The toner image carried on the surface of the respective photosensitive drums **31** is sequentially transferred on the paper **4** under the negative transfer bias voltage applied to the transfer rollers **19** while the paper **4** carried by the carrier belt **18** is fed through the respective transfer positions between the photosensitive drums **31** and the transfer rollers **19**. The paper **4** on which the toner image has been transferred is fed to a fixation unit **43**.

The fixation unit **43** is disposed to the rear of the carrier belt **18** within the body casing **2**, and provided with a heat roller **44** including a heat source, for example, a halogen lamp, which is rotated to be driven, and a press roller **45** oppositely positioned to press the heat roller **44** and driven through rotation. The fixation unit **43** heats the paper **4** that carries the four-colored toner image while being sandwiched and carried between the heat roller **44** and the press roller **45** so as to fix the toner image on the paper **4**. The thermally fixed paper **4** is carried to ejection rollers **47** at the upper portion of the body casing **2** by a carrier roller **46** diagonally backward above the fixation unit **43**. The paper **4** is then discharged onto the ejected paper tray **5** by the ejection rollers **47**.

The belt unit and peripheral structure thereof will be described in detail.

Referring to FIGS. **3** and **4**, the belt unit **15** is provided with the carrier belt **18** for carrying the paper, the support rollers **16** and **17** for supporting the carrier belt **18**, and a belt frame **50** that rotatably supports the support rollers **16** and **17**.

The belt frame **50** formed of an insulated synthetic resin material includes side walls **50**A and **50**B at left and right sides, which are connected at the lower side. The support rollers **16** and **17** are supported at the front and rear ends of the belt frame **50**, respectively. The support roller **17** is connected with a gear mechanism (not shown) provided in the body casing **2** upon installation of the belt unit **15** in the body casing **2**, and driven by power of a motor (not shown) provided in the body casing **2**.

The belt frame **50** is provided with four groove-like transfer roller fit portions **52** arranged in the longitudinal direction each extending in the lateral direction, and having the upper portion opened for accommodating the transfer roller **19**. The transfer roller **19** is formed by coating a metal roller shaft **19**A with a conductive rubber material **19**B. Both ends of the roller shaft **19**A extend from the left and right ends of the rubber material **19**B. Referring to FIG. **4**, roller shaft insertion holes **53** are formed through which the roller shaft **19**A of the transfer roller **19** is inserted at the left and right ends of the transfer roller fit portion **52** in the left and right side walls **50**A and **50**B of the belt frame **50** as shown in FIG. **4**. Each of the roller insertion holes **53** has a substantially rectangular shape, and dimensions in the vertical and longitudinal directions larger than the outer diameter of the roller shaft **19**A. In the state where the belt unit **15** is detached from the body casing **2**, the roller shaft **19**A is allowed to be displaced in the radial direction (vertical and longitudinal directions) within the range of the roller shaft insertion hole **53**.

A restriction member **55** is attached to the left end of the roller shaft **19**A of the transfer roller **19** as shown in FIG. **3**. The restriction member **55** is attached such that the roller shaft **19**A is allowed to be inserted through the center cylindrical portion (not shown in detail). It is attached to be relatively rotatable around the axis of the roller shaft **19**A, and not to be relatively shifted along the axial direction. The restriction member **55** is provided with a pair of plate-like restriction portions extending from the cylindrical portion thereof in the longitudinal direction (radial direction of the roller shaft **19**A). The transfer roller fit portion **52** of the belt frame **50** has a groove portion **56** that extends in the longitudinal direction and opens upward, with which the plate-like restriction portion of the restriction member **55** is fit. The plate-like restriction portion of the restriction member **55** has a convex surface **55**A with arc-like cross section of both side surfaces. The left and right convex surfaces **55**A abut against the inner wall of the groove portion **56** such that the transfer roller **19** is positioned in the axial direction, and the sliding displacement of the roller shaft **19**A in the radial direction (vertical and longitudinal directions) is allowed as well as the tilting thereof in the radial direction.

Referring to FIG. **4**, the belt unit **15** of the example structure is combined with a guide member **101** for guiding the paper. Referring to FIGS. **1** and **2**, the guide member **101** serves to guide the paper ejected by the pick-up roller **10** corresponding to the ejection mechanism installed in the body casing **2** onto the carrier belt **18**. The guide member **101** and the belt unit **15** are combined into a single unit so as to be moveable with respect to the pick-up roller **10** and attachable to and detachable from the body casing **2**.

Referring to FIG. **4**, the guide member **101** has a portion (guide portion **101**B) serving as a cover member that covers an upper portion of a carrier surface **18**A of the carrier belt as well as a grip portion held by the operator for attachment or detachment of the belt unit **15**.

The guide member **101** integrally formed with the side walls **50**A and **50**B of the belt frame **50** into a single unit to extend upstream of the carrier belt **18** in the carrier direction (front side of FIG. **1**). The guide member **101** includes a guide surface **101**C for guiding the paper, a curved portion **101**A and the guide portion **101**B. The curved portion **101**A forms a portion of a carrier path that turns back the fed paper, which serves as a curved wall to form the upper convex portion.

The curved portion **101**A is at the level that exceeds the height of the carrier belt **18**. The guide portion **101**B extends diagonally downward from the position higher than the carrier belt **18**, and has an end portion opposite to the carrier surface **18**A of the carrier belt **18**. The guide member **101** and the belt frame **50** do not have to be formed as an integrally molded product so long as they are combined. For example, the guide member **101** and the belt frame **50** which are independently molded may be fixed together with a screw, for example.

The guide member **101** has an opening **101**D that opens downward so as to allow fingers of the operator to be inserted from the lower portion thereinto. The space upward of the opening **101**D is defined by the curved portion **101**A, the guide portion **101**B, and left and right side walls (In FIG. **4**, one of the side walls, **101**E is only shown). The guide portion **101**B, and the left and right side walls **101**E and **101**F are continued with an rising wall portion **101**G which is connected to the left and right side walls **50**A and SOB of the belt frame **50** via a bottom wall **101**H.

Referring to FIGS. **1** and **2**, a tension mechanism **70** including a coil spring **54** is provided at the front end of the belt unit **15** at the side of the body casing **2**. More specifically, the tension mechanism **70** is provided with a pair of left and right levers **71** having the center portion rotatably supported at a rotary shaft **71**A along the lateral direction (one side is only shown in FIG. **1**), and a pair of coil springs **54** each urging the respective levers **71** (one side is only shown in FIG. **1**). Each of the coil springs **54** has the rear end fixed to the body casing **2**, and the front end as a free end connected to the lower end portion of the respective levers **71**. Each of the levers **71** has the upper end portion swingable against the elastic force applied by the coil spring **54**. Two pairs of the levers **71** and the coil springs **54** are arranged to interpose the front end of the accommodated belt unit **15** between the pair of the levers **71**.

The portion of the device for accommodating the belt unit **15** is provided with unit support portions **59** and **60** for positioning the belt unit **15**. The unit support portion **59** supports a pair of left and right bearings **16**A each of which supports the left end and right end of the roller shaft of the support roller **16** that extends from the frame **51** of the belt unit **15**. A guide groove **60**A is formed in the unit support portion **60** (see FIG. **1**), through which a pair of bearings **17**A each supporting the left end and right end of the roller shaft of the support roller **17** in the belt unit **15** is inserted. The aforementioned state represents the state where the belt unit **15** is normally installed in the body casing **2**.

In the normally installed state as described above, the upper end of each of the levers **71** abuts against the bearing **16**A of the belt support roller **16** from backside. The support roller **16** is urged in the direction (forward) where the belt support roller **16** is apart from the support roller **17** under the elastic force of the coil spring **54** so as to apply the tensile force to the carrier belt **18**.

A belt tension release portion (not shown) is installed in the body casing **2**, which retracts the upper portion of the lever **71** upon activation while expanding the coil spring **54** elastically so as to allow passage of the bearing **16**A.

Meanwhile, a metal frame **58** is provided within the body casing **2** so as to cover left and right sides of the process cartridges **26** and the belt unit **15**, respectively. Pairs of the unit support portions **59** and **60** are provided at the front and rear portions of the frame **58**, respectively as shown in FIG. **1**. The unit support portion **60** at the rear side has the open upper portion with which a bearing **17**A that rotatably supports the end of the belt support roller **17** at the rear side is fit as shown in FIG. **5**A. As the bearing **17**A is retained with the tension mechanism, the support roller **17** is held in position. The unit support portion **59** at the front side has a portion of the upper surface as a horizontal surface **59**A at a constant height. The

bearing **16**A is disposed on the horizontal surface **59**A such that the belt support roller **16** is held in position in the height direction. The horizontal surface **59**A of the unit support portion **59** at the front side allows the longitudinal displacement of the belt support roller **16**.

The frame **58** is provided with pairs of left and right bearing members **63**L and **63**R corresponding to the respective transfer rollers **19** for supporting the roller shafts **19**A thereof at the left and right sides as shown in FIGS. **1** to **3**. Each of the bearing members **63**L and **63**R has a bearing groove **64** with the upper portion opened, with which an end of the roller shaft **19**A is fit from upward such that the roller shaft **19**A is rotatably supported. A guide surface **65** is formed at the open edge of the bearing groove **64** into which the roller shaft **19**A is introduced. The bearing member at the left side of the bearing members **63**L and **63**R shown in FIG. **3**, that is, **63**L is formed of an insulated synthetic resin material, and attached to the frame **58** so as to be allowed to have a vertical displacement. Meanwhile, it is held in position with respect to the longitudinal and lateral directions of the frame **58**. A spring **66** is attached to the lower portion of the bearing member **63**L so as to be urged upward by the spring **66**.

The bearing member **63**R at the right side of the drawing is formed of an electrically conductive synthetic resin material, and is attached to the insulated member **67** formed of the insulated synthetic resin material fixed to the frame **58** so as to be allowed to have a vertical displacement. Meanwhile, it is held in position with respect to the insulated member **67** in the longitudinal and lateral directions. The spring **66** having conductivity is attached to the lower portion of the right bearing member **63**R at the right side so as to be urged upward thereby. The lower end of the spring **66** is connected to one end of an electrode plate **68**. The other end of the electrode plate **68** extends outward from the frame **58**, which is connected to the transfer bias application unit (not shown) provided within the body casing **2**. The transfer bias application unit is electrically connected to the transfer roller **19** via the electrode plate **68**, the spring **66**, and the bearing member **63**R such that the transfer bias is applied between the transfer roller **19** and the photosensitive drum **31** upon the image forming process.

The photosensitive drum **31** includes a drum shaft **31**A extending from both ends of the drum body as shown in FIG. **3**. Bearing bodies **80** each formed of the synthetic resin material are rotatably provided around the outer peripheries of the respective ends of the drum shaft **31**A. The frame **58** includes drum positioning grooves **81** at left and right sides corresponding to the respective photosensitive drums **31**. As the bearing body **80** is fit with each of the left and right drum positioning grooves **81**, the drum shaft **31**A is rotatably supported in position with respect to the frame **58**. The drum shaft **31**A is connected to a gear mechanism (not shown) within the body casing **2**, and the photosensitive drum **31** is driven by a power of a motor (not shown).

The example structure has a frame **111** that holds four process cartridges **26** within the body casing **2**. Referring to FIG. **6**, an image forming unit **110** formed of the frame **111** and those four process cartridges **26** may be detached from an opening **2**A formed in the body casing **2**. In order to detach the carrier belt **18**, the front cover **3** is opened as shown in FIG. **2**, and the image forming unit **110** is pulled out as shown in FIG. **6** so as to have access to the belt unit **15** via the opening **2**A.

The belt unit **15** is detachable with respect to the body casing **2** via the opening **2**A in the state where the image forming unit **110** is detached from the body casing **2** as shown in FIGS. **7** and **8**. In the example structure, as the guide member **101** combined with the belt unit **15** is at the position closer to the opening **2**A than the carrier belt **18**. Pulling out the image forming unit **110** allows easy access to the guide member **101** via the opening **2**A. Accordingly, the belt unit **15** may be easily detached from the body casing **2** while gripping the guide member **101**.

Referring to FIG. **5**A, a pivot shaft **105** is supported by one of a pair of support portions **103** at the left and right sides of the body of the apparatus at a position different from that of the rotary shaft of the support roller **17**, opposite to the side where the guide member **101** combined with the belt unit **15** is provided. The pivot shaft **105** extends in parallel with the rotary shaft of the support roller **17**, having the rear lower portion of both left and right ends supported at the pair of support portions **103**. In the example structure, when the belt unit **15** is pivotally turned with respect to the pivot shaft **105** while lifting up the guide member **101** as shown in FIG. **5**B, the rotary shaft (roller shaft) of the support roller **17** and the bearing **17**A displace upward to go through the guide groove **60**A of the unit support portion **60** such that the belt unit **15** is allowed to be detached from the installed position.

Meanwhile, the belt unit **15** is inserted through the opening **2**A to allow the bearings **17**A at both ends of the rear support roller **17** to be engaged with the guide groove **60**A of the unit support portion **60**, and the bearings **16**A at both ends of the front support roller **16** to be placed on the unit support portion **59** for the purpose of installing the belt unit **15** into the body casing **2**. This makes it possible to hold the belt unit **15** in a horizontal state by the unit support portions **59** and **60** arranged in the longitudinal direction. In the aforementioned process, both end portions of the roller shaft **19**A of each transfer roller **19** are guided into the bearing grooves **64** formed in the bearing members **63**L and **63**R so as to be fit therewith. This makes it possible to have the respective transfer rollers **19** positioned in the longitudinal direction.

Then the image forming unit **110** is slidably placed inside to install the respective process cartridges **26** upward of the belt unit **15**. The bearing bodies **80** at both ends of the drum shaft **31**A are fit with the respective drum positioning grooves **81** of the frame **58** so as to have the photosensitive drum **31** to be positioned with respect to the frame **58**. As the transfer roller **19** is pressed downward by the photosensitive drum **31** against the urging force applied by the spring **66**, the transfer roller **19** may be positioned in the vertical direction.

In the above-described structure, the belt unit **15** is combined with the guide member **101** that guides the paper, which are moveable with respect to the pick-up roller **10**, and attachable and/or detachable with respect to the body casing. As the guide member **101** that guides the paper to the carrier belt **18**, and the belt unit **15** are combined, the accuracy in positioning of the guide member **101** and the carrier belt **18** may be effectively improved. When the belt unit **15** is attached or detached, the guide member **101** functions as the grip portion. Accordingly the guide member **101** and the belt unit **15** in combination may be attached to or detached from the body casing as the moveable unit with respect to an ejection mechanism. This makes it possible to allow easy attachment or detachment of the belt unit **15** as well as improvement of the maintenance operation.

A portion of the guide member **101** serves as a cover member that covers the carrier surface **18**A of the carrier belt **18** so as to prevent the contact between the operator's hand and the carrier belt **18**. As the guide member **101** extends to the position closer to the opening **2**A than the carrier belt **18**, it becomes closer to the opening **2**A than the carrier belt **18**. This makes it possible to allow easy access to the guide member **101** during detachment of the belt unit **15**. The belt unit **15** may be installed with no need of deep insertion of the

operator's hand. The attachment or detachment of the belt unit, thus, may be easily performed.

The pivot shaft **105** is supported by the support portion **103** of the apparatus at a position different from that of the rotary shaft of the support roller **17**, opposite to the side where the guide member **101** combined with the belt unit **15** is provided. The belt unit **15** is pivotally operated around the pivot shaft **105** so as to be detached from the device. Accordingly, the belt unit **15** may be easily detached by operating the guide member **101**.

In the body casing **2**, the image forming unit **110** formed on frame **111** that supports a plurality of cartridges is detachably held at the frame **111** and is allowed to be pulled out from the body casing **2**. The aforementioned image forming unit **110** may be detached from the opening **2**A formed in the body casing **2**. The belt unit **15** may be attached or detached with respect to the body casing **2** via the opening **2**A in the state where the image forming unit **110** is detached from the body casing **2**. This makes it possible to perform the maintenance of the belt unit **15** independently from the image forming unit **110** while using the opening **2**A for attachment or detachment of both units.

In the example structure, the paper feed tray **7** is allowed to be pulled out from the body casing **2** at one side surface (that is, front surface side). The front cover **3** that is capable of opening and closing the opening **2**A formed in the body casing **2** is provided on the side surface (front surface) from where the paper feed tray **7** is pulled out. The belt unit **15**, thus, is allowed to be attached or detached via the opening **2**A. The above-described structure allows both detachment of the belt unit **15** and withdrawal of the paper feed tray **7** to be performed from the same side, resulting in considerably convenient structure.

Another example structure of the present invention will be described referring to FIGS. **9** to **12**.

The example structure is a color laser printer **80** of intermediate transfer tandem type using an intermediate transfer belt **86**. The components of the structure which are the same as those described in the aforementioned example will be designated with the same reference numerals, and the explanation thereof, thus, will be omitted.

The laser printer **80** includes a belt unit **81** that is attachable to and detachable from the body casing **2**. The belt unit **81** has a belt frame **82** formed of an insulated synthetic resin material with a substantially triangle side view. Belt support rollers **83**, **84**, and **85** are provided at the front end, rear end and lower end of the belt frame **82**, respectively, by which an intermediate transfer belt **86** extends thereamong. Four transfer rollers **19** are arranged on the upper surface of the belt frame **82**. A secondary transfer roller **87** opposite to the belt support roller **85** at the lower end of the belt frame **82** with respect to the intermediate transfer belt **86** is provided at the lower portion of the belt unit **81**. The secondary transfer bias is applied between the secondary transfer roller **87** and the belt support roller **85**. In the laser printer **80**, the toner image generated by four photosensitive drums **31** is transferred onto the intermediate transfer belt **86** in four colors, and thereafter, the toner image transferred onto the intermediate transfer belt **86** is further transferred onto the paper **4** while passing through the press contact position between the secondary transfer roller **87** and the intermediate transfer belt **86**. The intermediate transfer belt **86** functions as the carrier belt that grips the paper **4** with the secondary transfer roller **87** so as to be carried in the belt running direction and to transfer the toner image thereon.

A frame (not shown) within the body casing **2** is provided with a pair of unit support portions at the front and rear sides for supporting the belt support rollers **83** and **84** at the front and rear sides, respectively. In the example shown in FIG. **9**, the unit support portion **59** that supports the support roller **84** is only shown, and the unit support portion that supports the support roller **83** is not shown. However, the example may have the same structure as that of the unit support portion **60** shown in FIG. **1**. The frame is also provided with a pair of bearing members corresponding to the transfer roller **19** at left and right sides for supporting the roller shaft **19**A of the transfer roller **19**. The example of FIG. **9** shows one of those bearing members, that is, the bearing member **63**L only.

In the example structure shown in FIG. **11**, the belt unit **81** is combined with a guide member **121** that guides the paper. Referring to FIG. **12**, the guide member **121** and the belt unit **81** can move in combination with respect to the pick-up roller **10**, and are attachable and/or detachable with respect to the body casing. As the guide member **121** that guides the paper into the intermediate transfer belt **86** is combined with the belt unit **81**, the accuracy in positioning of the guide member **121** and the intermediate transfer belt **86** is improved to higher degrees. Moreover, upon attachment or detachment of the belt unit **81**, a portion of the guide member **121** is allowed to function as the grip portion. This makes it possible to perform attachment or detachment of the guide member **121** and the belt unit **81** in combination with respect to the body casing **2**.

The guide member **121** extends upstream of the intermediate transfer belt **86** in the carrier direction with respect to the secondary transfer roller **87**. This may eliminate the need of accessing the area around the carrier surface of the intermediate transfer belt **86** for locating a position to grip during attachment or detachment. Thus, interaction on the carrier surface is unlikely, thus providing more protection to the carrier belt.

Referring to FIG. **10**, the opening **2**A is formed in a portion of the body casing **2**. Referring to FIG. **12**, the belt unit **81** is detachably provided with respect to the body casing via the opening **2**A. The guide member **121** is arranged at the position closer to the opening **2**A than the intermediate transfer belt **86**. As the guide member **121** is closer to the opening **2**A than the intermediate transfer belt **86**, access to the guide member **121** is improved, thus making it easier for attaching and/or detaching the belt unit **81**. The belt unit **81** may be easily attached with no need of inserting the operator's hand so deeply. This makes it possible to perform the attachment or detachment of the belt unit easily.

An image forming unit **110** formed of a frame **111** that supports a plurality of pairs of process cartridges **26** is detachably held by frame **111** and is allowed to be pulled out from the body casing **2**. The image forming unit **110** is allowed to be attached to and detached from the opening **2**A of the body casing **2** as shown in FIG. **10**. The belt unit **81** is detachably provided with respect to the body casing **2** via the opening **2**A as shown in FIG. **12** in the state where the image forming unit **110** is detached from the body casing **2** as shown in FIG. **10**. The belt unit **81** may be maintained independent from the image forming unit **110**, thus using the opening **2**A for attachment or detachment of both the image forming unit and the belt unit, respectively.

In the example structure, the paper feed tray **7** may be pulled out from one side surface (that is, front surface side) of the body casing **2**. The front cover **3** serving to open and close the opening **2**A formed in the body casing **2** is provided at the one side surface (front surface) from where the paper feed tray **7** is pulled out. The belt unit **81** may be detachably provided at the one side surface via the opening **2**A. The detachment of the belt unit **81** and withdrawal of the paper

feed tray **7** may be performed from the same side, resulting in the structure with improved convenience.

the combination of the belt unit and the guide member described herein may be formed as an integrally molded product of the part of the belt unit (for example, frame) and the guide member. Alternatively, it may be structured by fixing an independent guide member to the part of the belt unit (for example, frame).

What is claimed is:

1. An image forming apparatus comprising:

a body casing that accommodates a storage portion for storing a recording medium in a bottom portion of said body casing, and an image forming unit that forms an image on said recording medium;

an opening formed in a side portion of said body casing;

an ejection mechanism provided within said body casing for ejecting said recording medium stored in said storage portion;

a guide member that guides said recording medium ejected by said ejection mechanism in a predetermined direction;

a belt unit, said belt unit carrying said recording medium guided by said guide member toward said image forming unit, wherein:

said belt unit further includes a frame portion, a plurality of support rollers rotatably provided to said frame portion, and a carrier belt extended between said support rollers for carrying said recording medium guided by said guide member;

at least a portion of said guide member is arranged at a position closer to said opening than said carrier belt with said belt unit installed in the body casing;

said image forming unit is configured to be removed from said body casing through said opening independent of said belt unit, and

said guide member and said belt unit are combined and are attachably and detachably provided with respect to said body casing via said opening.

2. The image forming apparatus according to claim **1**, wherein a portion of said guide member covers a carrier surface of said carrier belt.

3. The image forming apparatus according to claim **2**, wherein said guide member extends in a carrier direction at one of upstream and downstream of said carrier belt.

4. The image forming apparatus according to claim **2**, wherein said image forming unit includes a photosensitive drum and a development unit provided upward of said belt unit within said body casing.

5. The image forming apparatus according to claim **4**, wherein

a storage member for storing said recording medium at one side surface of said body casing is provided so as to be pulled out and a cover member allowed to open and close said opening formed in said body casing is provided at said one side surface from where said storage member is pulled out.

6. An image forming apparatus comprising:

a body casing that accommodates a storage portion for storing a recording medium in a bottom portion of said body casing, and an image forming unit that forms an image on said recording medium;

an opening formed in a side portion of said body casing;

an ejection mechanism provided within said body casing for ejecting said recording medium stored in said storage portion;

a guide member that guides said recording medium ejected by said ejection mechanism in a predetermined direction;

a belt unit, said belt unit carrying said recording medium guided by said guide member toward said image forming unit, said belt unit further including a frame portion, a plurality of support rollers each being provided to said frame portion and having respective rotary shafts laterally extending from said frame portion, and a carrier belt extended between said support rollers for carrying said recording medium guided by said guide member; and

a bearing member provided at a side of said body casing, which rotatably supports the rotary shafts of said support rollers in a positioned state, wherein:

said guide member and said belt unit in combination are attachably and detachably provided with respect to said body casing via said opening, and

at least a portion of said guide member is arranged at a position closer to said opening than said carrier belt with said belt unit installed in the body casing,

wherein said image forming unit is configured to be detached from the body casing through said opening independent of said belt unit.

7. The image forming apparatus according to claim **6**, wherein said belt unit is provided with a pivot shaft at an end portion opposite to a side where said guide member is provided, and a support portion that pivotally supports said pivot shaft provided within said body casing.

8. The image forming apparatus according to claim **7**, wherein a portion of said guide member covers a carrier surface of said carrier belt.

9. The image forming apparatus according to claim **6**, wherein said guide member extends in a carrier direction at one of upstream and downstream of said carrier belt.

10. The image forming apparatus according to claim **6**, wherein said image forming unit includes a photosensitive drum and a development unit provided upward of said belt unit within said body casing.

11. The image forming apparatus according to claim **10**, wherein

a storage member for storing said recording medium at one side surface of said body casing is provided so as to be pulled out, and

a cover member allowed to open and close said opening formed in said body casing is provided at said one side surface from where said storage member is pulled out.

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